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Investigation of the CHOKAI score used to predict ureteral stones in patients presenting to the emergency department with renal colic

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ABSTRACT

Aim: To investigate the adequacy of the CHOKAI score in the prediction of ureteral stones in patients presenting to the emergency department with renal colic.

Material and Method: The data of all patients aged over 18 years, who presented to the emergency department with the complaint of renal colic and were diagnosed with ureteral stones during the study period were retrospectively analyzed using the electronic-based hospital information system. The area under the receiver operating characteristic curve and the area under the curve were used to assess for each patient to determine the cut-off value of the CHOKAI score in the prediction of ureteral stones.

Results: The study was completed with 219 patients, of whom 146 were men, and the mean age was 39.4±16.1 years. When the cut-off value of the CHOKAI score was >6, its sensitivity was 84.1%, specificity was 96.7%, positive likelihood ratio was 25.2, negative likelihood ratio was 0.2, positive predictive value was 99.4%, and negative predictive value was 49.2%.

Conclusion: In this study, it was concluded that the CHOKAI score had high accuracy in terms of diagnostic power in detecting ureteral stones. However, further studies are needed to demonstrate the broader applicability of the score.

Keywords: CHOKAI score, diagnosis, emergency medicine, ureter

INTRODUCTION

While the prevalence of urolithiasis was one in 20 people in 1994, it increased to one in 14 people in 2010. The general prevalence of urinary system stone disease in Turkey has been reported as 14.8%. In Turkey, the incidence of this disease in men is three times higher compared to women. There is a recurrence rate of approximately 50% within five years of stone formation. In developed countries, it is seen at a rate of 1-5%. The average lifetime prevalence of symptomatic urolithiasis is 13% in men and 7% in women. In recent years, the prevalence of stone disease has been increasing due to dietary habits and dietary changes in Western societies. Twenty-five percent of patients with urolithiasis have a family history of the disease. The incidence of urolithiasis is also higher in Caucasians and in cold climates. In Turkey, the disease is more commonly seen in the Mediterranean, Black Sea and Southeastern Anatolia regions (1-5).

Scoring systems are widely used in emergency practice. Using scoring systems, early diagnosis and rapid intervention are possible in many critical diseases, such as acute abdomen and gastrointestinal bleeding (6-9). Scoring systems have also been developed for early diagnosis in patients with renal colic, which is one of the most common reasons for presentation to the emergency department. The CHOKAI score was developed by Fukuhara et al. in 2017 to predict the presence of ureteral stones. This score consists of seven parameters including nausea or vomiting, hydronephrosis, hematuria, stone history, gender, age, and pain duration, each scored from 0 to 4, and the total score varies between 0 and 13. While 0-5 points represent low risk for ureteral stones, 6-13 points indicate high risk (10).

The aim of this study was to investigate the adequacy of the CHOKAI score in the prediction of ureteral stones in patients presenting to the emergency department with renal colic.

MATERIAL AND METHOD

This single-center, retrospective, and observational study was carried out in the emergency department of a tertiary teaching hospital between July 1, 2021, and January 1, 2022. The research was approved by the Kartal Dr. Lütfi Kırdar City Hospital Clinical Researches Ethics Committee (Date: 30.03.2022, Decision No: 2022/514/222/20). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

During the period determined for the study, all the patients aged over 18 years, who presented to the emergency department with the complaint of renal colic and were diagnosed with ureteral stones using computed tomography (CT) constituted the population of the study. Patients with abnormal vital signs (high fever and hypotension), active cancer, and leukocytes in urinalysis and C-reactive protein concentration of ≥ 6 mg/L, those who did not undergo ultrasound (USG)-CT or complete urinalysis, and those whose CHOKAI score could not be calculated were excluded. After recording the data of each patient included in the study, their CHOKAI scores were separately calculated. The accuracy of the CHOKAI score was determined with reference to CT, which is the gold standard in the diagnosis of ureteral stones.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 26.0 and MedCalc Statistical Software version 19.0.6. Descriptive criteria were presented as median, minimum-maximum, and percentage values. The conformity of the data to the normal distribution was checked with the Kolmogorov-Smirnov test. The receiver operating characteristic (ROC) analysis was used to determine the cut-off value of the CHOKAI score in detecting ureteral stones. The ROC analysis was performed using the DeLong method. The area under the curve (AUC), sensitivity, specificity, positive likelihood ratio (LR+), negative likelihood ratio (LR-), positive predictive value (PPV), negative predictive value (NPV), and Youden's J index (YJI) were calculated to evaluate the performance of the CHOKAI score in predicting ureteral stones. The statistical significance level was taken as $p < 0.05$.

RESULTS

This study was completed with a total of 219 patients with a mean age of 39.4±16.1 years. Seventy-three patients were female and 146 were male. Various characteristics of the individuals participating in the study are presented in **Table 1**.

Table 1. General characteristics of the study population					
	Min	Max	Mean Number	SD	Percentage
Age	16.0	92.0	39.4	16.1	
Gender					
Female			73		33.3
Male			146		66.6
Nausea			77		35.2
Vomiting			20		9.1
Onset of pain					
<6 hours			86		39.3
6-24 hours			64		29.2
>24 hours			69		31.5
Stone			189		86.3
Stone side					
Right			97		47.3
Left			108		52.7
Stone localization					
Proximal			32		16.9
Middle			21		11.1
Distal			136		72.0
Hematuria			139		63.5
Stone history			88		40.2
Hydronephrosis			186		84.9
Stone size	3.0	20.0	6.2	2.5	
CHOKAI score	1.0	13.0	8.4	2.9	
SD, standard deviation					

As a result of the ROC analysis of the CHOAKI score in the prediction of urinary stones, the AUC value was calculated as 0.959 (95% confidence interval: 0.923-0.981), and YJI was 0.808. According to the statistical analysis, the CHOAKI score was statistically significant in predicting the presence of stones. When the cut-off value of the CHOKAI score was taken as >6, it had a sensitivity of 84.1%, specificity of 96.7%, LR+ value of 25.2, LR- value of 0.2, PPV of 99.4%, and NPV of 49.2% (**Table 2**, **Figure 1**).
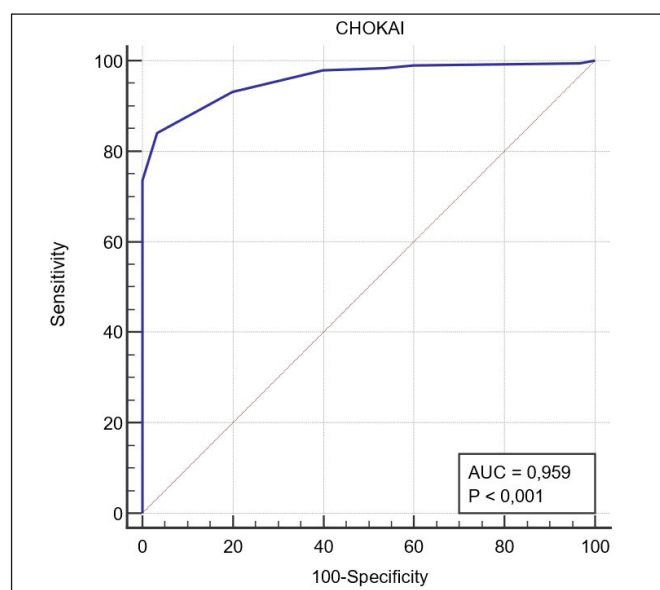
Figure 1. Receiver operating characteristic curve of the CHOKAI score (AUC, area under the curve)

Table 2. Results of the ROC analysis of the CHOKAI score for the diagnosis of ureteral stones								
	AUC	Cut-off	Sensitivity	Specificity	LR+	LR-	PPV	NPV	Youden's index
CHOKAI score	0.959 (0.923-0.981)	>6	84.1(77.5-88.3)	96.7(82.7-99.4)	25.2	0.2	99.4	49.2	0.808

AUC, area under the curve; LR+, positive likelihood ratio; LR-, negative likelihood ratio; PPV, positive predictive value; NPV, negative predictive value

Emem et al. Shoulder joint and rotator cuff tear and acromion types

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DISCUSSION

Renal colic is one of the common reasons for presentation to the emergency department. Generally, these patients have very severe pain complaints and require early diagnosis and pain palliation. The current study aimed to validate the CHOKAI score in the prediction of ureteral stones in patients presentation to the emergency department with renal colic. It was concluded that the CHOKAI score had high diagnostic accuracy with an AUC value of 0.95.

In 2017, Fukuhara et al. (10) defined the CHOKAI score in a study conducted with 96 patients of Japanese origin, and reported the AUC value of this score to be 0.97 at a cut-off value of 6. The authors reported the LR+ and LR- values of the score as 15.49 and 0.094, respectively. It is generally accepted that LR+ >10 and LR- <0.1 provide strong evidence to rule out or not exclude a diagnosis (11). In the current study, we determined that at a cut-off value of >6, the CHOKAI score had an LR+ value of 25.2 and LR- value of 0.2.

When used together with other parameters in the diagnosis of urolithiasis, in addition to its diagnostic advantage, ultrasonography (USG) has been reported to provide a significant reduction in the cumulative radiation exposure caused by repeated CT imaging and the duration of stay in the emergency department (12,13). In cases where USG will not be used as a diagnostic imaging method, in order to reduce radiation exposure, the American Association of Urology (AUA) and the European Association of Urology (EAU) recommend using low-dose CT, which has almost the same sensitivity and specificity as non-contrast CT, in the detection of ureteral stones (14). The CHOKAI score also involves checking whether there is hydronephrosis on USG for the prediction of ureteral stones, and the presence of hydronephrosis is scored 4 points.

When studies on the CHOKAI score in the literature are examined, it is observed that this score was mostly compared with the STONE scoring system. The STONE score, which was defined by Moore et al. (15) consists of five variables (gender, duration of pain, race, nausea-vomiting, and hematuria), each scored between 0 and 13. In calculating the probability of kidney stones, 0-5, 6-9, and 10-13 points represent low, moderate and high probability, respectively. In a multicenter prospective validation of the CHOKAI score, it was found to have an AUC value of 0.95, sensitivity of 0.93, specificity of 0.90, LR+ of 9.3, and LR- of 0.079. In the same study, it was reported that at an AUC value of 0.88, the STONE score had a sensitivity of 0.68, specificity of 0.90, LR+ of 6.8, and LR- of 0.36 (16). In another study comparing the two scores, the sensitivity of the CHOKAI score

in detecting ureteral stones was 83% and its specificity was 94.87%, while the cut-off value was calculated to be >6 (AUC=0.945). The STONE score was found to have a sensitivity of 79.50% and specificity of 84.62% in detecting ureteral stones, and its cut-off value was found to be >6 (AUC=0.860) (17). In a study conducted in Turkey, the external validation of the STONE and CHOKAI scores was performed, and the specificity and sensitivity values in the diagnosis of ureteral stones were determined to be 64.71% and 71.70%, respectively for the STONE score and 66.67 and 90.57, respectively for the CHOKAI score (18). The results of our study were similar to previous studies in the literature. When the cut-off value of the CHOKAI score was taken as >6 in determining the presence of stones, the sensitivity was calculated as 84.1%, specificity as 96.7%, LR+ as 25.2, LR- as 0.2, PPV as 99.4%, and NPV as 49.2.

Limitations

The main limitation of our study is its single-center design and retrospective design. Since CT is the gold standard in the diagnosis of ureteral stones and USG was used in the CHOKAI scoring system, we excluded patients who did not undergo CT and USG, which resulted in a smaller sample size.

CONCLUSION

In this study, it was determined that the CHOKAI score had high accuracy in terms of diagnostic power in detecting ureteral stones. However, further studies are needed to demonstrate the wider applicability of this scoring system.

ETHICAL DECLARATIONS

Ethics Committee Approval: The research was approved by the Kartal Dr. Lütfi Kırdar City Hospital Clinical Researches Ethics Committee. (Date: 30.03.2022, Decision No: 2022/514/222/20).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The author has no conflicts of interest to declare.

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Author Contributions: The author declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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